

Economic implication of climate change and soil management practices in Nigeria, Empirical in-depth analysis

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ABSTRACT

Agriculture which is the main occupation of majority of rural dwellers in Nigeria has suffered a huge setback due to mostly total neglect and abandonment by successive government coupled with climatic variations and unsuitable soil management practices employed by the household farmers, and thus the essence of this study; economic implication of climate change and soil management practices in Nigeria. The devastating impacts of climate change in Nigeria cannot be ruled off with its significant evidences across the agro-ecological zones. The havoc caused by variations in climate change is second to none. These impacts have been felt virtually across all sectors of the economy namely health, security, energy, transportation, agriculture, etc. However, in as much as climate change poses adverse effects in Nigeria, its positive side though highly debatable cannot be ruled out for instance, rising temperatures and heat waves in most cases activate and aid soil microbial organisms, thus enhancing soil aeration, soil structure and texture which further aid and support agricultural production of the household farmers. Greater attention is thus being given to intensification of sustainable soil management technologies. Key benefits of these technologies are; increasing food production without depleting soil and water resources, restoring soil fertility, increasing the resilience of farming systems to climatic risk, and improving their capacity to sequester carbon and climate change mitigation. Conclusively, farmers should embrace climate change mitigation strategies and adaptative principles and incorporate efficient and effective soil management techniques to forestall future climatic occurrences and boost farm production and income.

Keywords: Agriculture, Economic Impacts, Climate Change, Soil Management Practices.

INTRODUCTION

Agriculture which is the bedrock occupation of the rural households has experienced a lot of dwindling due to total neglect and other factors such as climate change and soil management practices employed by the household farmers. Empirical studies have shown that climate change can distort the pathway for economic growth and increase the poverty status of farming households in Nigeria [1]. There have been noticeable changes in Nigeria's climate apparent in: increases in loss of biodiversity, water resources, high temperature; rainfall variations; rise in sea level and flooding; land degradation, drought and desertification. Nigeria has witnessed increased run-offs due to

rainfall intensities and untold variations which had negatively affected household income and agricultural productivity at large [2]. Variation in rainfall is expected to continue to rise with the southern areas experiencing rising precipitation of sea levels and to an extent exacerbate submersion of the coastal lands cum flooding. Droughts have equally become a predominant factor in the Northern Nigeria, occasioned from a decline in precipitation and increase in temperature [3]. Land degradation is a serious problem that contributes to the low and declining agricultural productivity, food insecurity and increased poverty among farming households in Nigeria [4]. Climate projections in Nigeria had constantly revealed a significant increase in temperature and

rainfall over all the ecological zones. This outcome is expected to trigger concerns as it affects agricultural production which initiates a multiplier effect on the income of the household farmers in general [5]. Soil management practices refer to variety of operations with respect to soil that aid production of food crops. It reveals all operations, practices and treatments used to protect the soil and enhance its performance [6]. The concept of soil management practices should not only take into account the risks of field location and topography, but also the choice of crops, cultivation methods and/or stocking levels, maximum economic levels of production per hectare of land and good environmental management [7]. A good soil management has the ability to resist erosion, compaction and other environmental stresses while maintaining economic productivity. Good soil management practice in balance with accepted ecological and economic principles is more likely to ensure agricultural sustainability [8]. The recipe for minimizing soil degradation lies on good management practices which include minimum disturbance of soil during land clearing and tillage, all year round coverage of the soil surface, serial land clearing and proper use of fertilizer [9]. Managing our soils sustainably is very crucial for agricultural production and ecosystems. The economic implications of climate change and impacts of poor soil management practices are becoming so severe in many parts of the world that the adoption of sustainable soil management techniques is of crucial importance for future generations, hence the essence of this study.

IMPACTS OF CLIMATE CHANGE IN NIGERIA

The devastating impacts of climate change in Nigeria cannot be ruled off with its significant evidences across the agro-ecological zones. The havoc caused by the variations in climate change is second to none. These impacts have been seriously felt virtually across all the sectors and facets of the Nigerian economy.

POSITIVE IMPACTS OF CLIMATE CHANGE

In as much as climate change poses more of adverse effects in Nigeria, its positive side though highly debatable cannot be ruled out for instance, rising temperatures and heat waves in most cases activate and aid soil microbial organisms, thus enhancing soil aeration, soil structure and texture which further aid and support agricultural production of the household farmers [10]. Increase in agricultural production via rising temperatures in turn has a rapid multiplier effect on the income of the household farmers; hence this triggers reduction in poverty levels of the farmers. In addition, high precipitation (rainfall) and wind patterns aid farm productivity of the farmers especially in the northern part of Nigeria that experiences high drought seasons and less rainfall. It could be further observed that high precipitation prevent and protect the farms from crop diseases and pest infestation and this thrives green leaves maturation and increased output and yields of crops [11]. This high volume of rainfall sometimes substitutes the irrigation of most arable farmlands. Consequently, extreme weather conditions (high precipitation and temperature) in most cases support both land and forest vegetation and vegetative growth and production of edible forest fruits, etc.

NEGATIVE IMPACTS OF CLIMATE CHANGE

The despicable and negative impacts of climate change in Nigeria far outweighed its economic contributions and thus are streamlined on the following:

Agriculture:

Agriculture has been a dependent occupation of most rural households in Nigeria with over 60% of households participating in it as a means of livelihood and survival. Rising temperatures and unpredictable variations in rainfall due to climate change affects farm productions cum income of the households' farmers [12]. High temperatures initiates drought, land degradation and desertification of farmlands while increase in rainfall patterns leads to farm flooding and

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erosion of arable farmlands thereby undermining food supply and food security.

High food prices:

It is no doubt that adverse effect of climate change leads to a rise in food prices. Extreme climatic variations lower the quantity and supply of agricultural produce of the farmers and as such the limited available produce usually experiences a hike in prices [13].

Transportation:

Extreme climatic conditions such as high rainfall, increased temperature and heat waves triggers land degradation, denudation and vegetative removal which affect most of our road networks thereby making movement of goods and services extremely difficult.

Labour Supply:

There is shortage of farm labour supply due to the excessive heat generation from intense temperature, pressure and sun-light. This further makes farming very difficult and more strenuous to cope with, as majority of hired laborers prefer working at conducive periods rather than harsh atmosphere.

Poverty rise:

Climate change subject household farmers to intense poverty due to the poor and low returns from their farm production and other farming investments. A synergy exists between climate change and income of the farmers, any extreme variations in the former will invariably affect the latter [14].

Water-ways:

Our water which comprises of (rivers, oceans, lakes, etc) becomes over-flooded and excessively polluted due to climatic variations making it impossible and difficult to access clean and drinkable water for both human sustenance and other useful purposes, thus making fresh water in short supply.

Forestry:

Forestry's are heavily affected due to soil erosion; vegetative loss, and land degradations while excessive wind reduces the ability of the forest to reproduce and regenerate back when tampered [15].

Fisheries:

Aquatic lives and other water resources have been under threats due to Climate change exigencies. Rising sea levels and adverse weather conditions affects reproductions in fish and other aquatic animals [16].

Health:

Increased cases of meningitis have been recorded occasioned by rising temperatures. There is increased spread of infectious disease and water-borne illness (e.g. typhoid fever, cholera) not living out increased air pollution which affects human lungs and other body vital organs. Also malnutrition and undernourishment have persisted due to extreme weather conditions which result in food shortages [17].

Manufacturing/Industry:

There is shortage of industrial raw materials and other forest products and resources due to extreme weather and climatic variations that threatens our forestry's to a large extent. Some economic trees such as (iroko, melina, obeche, mahogany, etc) which produce forest woods all shrivels up at the emergence of climate change thus rendering our manufacturing/industrial sectors comatose.

Information Technology and Communication:

Extreme weather conditions affect mounted communication masks, causing breaching and breaking of transmission communication lines. Phone calls and communications are heavily affected during heavy rain falls and most times the lightening and thunders it triggers affect the power supply which causes damages on our household gadgets and other electrical appliances [18].

Aviation Sector:

The aviation industry is not spared out from climatic exigencies as extreme weather conditions puts both local and international flights on hold for days. Sometimes even when the planes are on board, extreme weather conditions forces them to return back to their base while some crash-out due to uncontrollable weather forces and wind pressures. These incidences have occurred severally in Nigeria.

Education:

Most school buildings in Nigeria had been destroyed and damaged by extreme weather variations mostly extreme wind pressures and rainfall and thus bridging learning and educational activities [19]. Furthermore, undue heat waves from intense temperature and sunlight causes hotness of our classrooms, hence making learning very difficult at such times.

Commerce:

It is obvious that extreme weather conditions limits trading activities as it forces both sellers and buyers to scamp for their lives and safety to avoid being harmed or drenched by the rain. High precipitation (rainfall) disturbs trading and thus making marketing activities extremely difficult as it forces shops, stores, warehouses, market outlets, etc to abruptly shut down in no time.

Religion:

Climate change affects our religion to an extent as weather variation and changes forces our worship centers to shut down and prevent worshippers from attending church services. Most times some worshippers that are privileged to be in their places of worships are trapped down waiting for the high rains to subside while some worshippers that steps out in faith in the high downpours with an umbrella regrettably saw their umbrella's being blown away or destroyed by heavy and intense wind and rain falls.

Environment:

Climate change adversely affects our environment as our lands and water-ways are polluted without

control [19]. It breeds environmental pollution, land degradations, denudation, drought, desertification, encroachments and destruction of aquatic lives.

Culture:

Culture as defined as people's way of life are heavily affected by climate change as extreme weather conditions prevents mostly our rural dwellers from exhibiting their various cultural activities such as folk tales, (tales by moonlight) dancing, singing, cooking, hunting, fishing and culturally related events and activities.

Petroleum/Mining:

The excavation and explorations of crude oil are adversely affected by climatic variations. Land degradations, denudations, and vegetative destruction orchestrated by extreme weather conditions makes crude oil drilling and mineral resource extractions (tin ore, coal, granite, etc) extremely difficult and challenging.

Financial/Economic sector:

The backdrop and low productivity witnessed in the agricultural sector due to climate change have threatened the exportations of farm produce leading to a drastic drop in gross domestic product (GDP) earnings, thus lowers economic developments [20]. Moreover, even some cash crops and other commercial crops which we have comparative advantage over other countries have suffered similar fate.

Power/Energy:

Excessive wind variations and increase in precipitations destroys mounted electric poles and most times causes extensive havoc on power generating transformers and transmission lines thereby bridging light supply. Lower rainfall for example, reduces the availability of trees and biomass for fuel which affects hydroelectric outputs and transmissions [21].

Crime/Social Vices:

It is not far-fetched that climate change breeds crimes and other social vices such as kid-napping, prostitution, robbery, internet fraud, etc. Due to the poor returns from agricultural activities resulting in poor and low income of household farmers, young and up-coming farmers are quick to embrace these ugly vices as a substitute means of livelihood.

Demographic impacts:

Climate variations adversely influence demographic set-ups such as age, gender, farm income, etc in varying ways and degrees. Aged people are mostly affected by extreme weather conditions which deplete their health and cause other illnesses. Also women are more vulnerable to climate change compared to men [22]. This is due to their weak and feminine disposition to mitigate the adverse excesses of climatic variations and this in turn affects their farm outputs and income levels.

Security impacts:

Both vegetative and land resources have been greatly affected by climate change. This is evident with the invasion of Fulani herdsmen across Nigeria ecological zones looking for good pastures for their cows and thus causing security breaches here and there (Inter-ethnic clashes). In a bid to fend for their animals, owing to limited resources they destroy farm produce of farmers, rape women and young girls, fight and kill farm owners when challenged [23]. This has caused lot havoc in terms of security breaches in Nigeria which the government is proposing a policy direction on Ruga settlement to ameliorate this ugly incidence.

Mass re-location:

Furthermore, there have been cases of inter-ethnic clashes and security breaches due to frequent vegetation depletion cum desert encroachment and land degradations in some ecological zone which has prompted massive emigration and resettlement of people to areas less threatened by desertification.

Geographic impacts:

The challenges occasioned by climate change differ across the geo-political zones of the country. Vulnerability analysis attests that states in the north experience higher degrees of vulnerability to climate change than those in the south [24], [25]. The increase in temperature and heat waves with less rainfall, dominant in the north initiates drought, desert encroachment, and land degradations with loss of the wet lands, and rapid reduction in the amount of surface water, flora and fauna resources on land. On the other hand, the southern part of Nigeria also suffers from the devastating impacts of climate change especially the (Niger Delta regions) due to the rising sea levels, increased precipitation, coastal erosion and flooding which has resulted in the displacement of many settlements and brought various internal displaced persons (IDP's) across the country.

TYPES OF SOIL MANAGEMENT PRACTICES AMONG HOUSEHOLD FARMERS IN NIGERIA

Empirical evidences of soil management practices among household farmers in Nigeria have been documented.

In Osun State, Nigeria [26] observed that farmers have varying degrees of adoption of soil management and conservation practices. More of the farmers used cover crops (99.2%) crop rotation (97.1%), multiple cropping (96.4%) and slash/manual removal of biomass (89.3%). Furthermore, they posited the respondents' use of cover crops as the most sustainable soil management technique with a mean use value of 2.9.

[27] In his findings on soil conservation management in Nigeria noted the use mulching, conservation tillage, strip cropping, cover cropping, inter cropping and contour hedges of perennials. They stated that these forms of soil management practices are effective in reducing risks of water run-off and soil erosion.

[28] In his study on crop farmers' use of environmentally sustainable agricultural practices

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in Ogun State Nigeria opined that majority of the crop farmers used mulching as a sustainable soil management practices in the area. He implied the use of mulching as a useful erosion control technology as this method reduces soil loss and enhances soil productivity and crop yields.

[29] In their studies on the awareness on the use of soil agricultural practices in Edo State, Nigeria reported that all the farmers in the area have knowledge of mixed cropping, while 95.6% and 87.8% were aware of cover cropping and organic manure. Others have knowledge of alley cropping, the use of green manure, crop rotation and minimum tillage system

[30] Investigated the barriers to adopting sustainable agricultural practices alongside with agricultural policies. They reported the use of mixed cropping; cover cropping, crop rotation, integrated pest management, alley cropping, ridging, organic manure application, green manure, minimum tillage system and mulching as forms of soil management technologies.

[31] Examined the effects of sustainable land management practices on agricultural production of arable crop farmers in Abia State, Nigeria. He noted that farmers in the area made use of crop rotation (15.6%), cover cropping (23.3%), Taungya farming (50.0%), multiple cropping (100.0%), erosion control (94.4%), alley cropping (30.0%), use of animal waste (63.3%), use of organic fertilizer (36.7%), crop residue recycling (76.7%) and use of inorganic fertilizer (45.6%). He opined that all the farmers adopted multiple cropping as their most sustainable soil management practice to avert the risk of total crop failure.

[32] examined the categorization of farmers in relation to use of sustainable land management practices in Ondo State, Nigeria. The study reported that farmers in Ondo State made sufficient use of mulching, crop rotation, contour cropping, strip cropping, planting of legumes, bush fallow system and shifting cultivation techniques in their various farms.

[33] in their studies on the evaluation of traditional soil fertility management practices for rice cultivation in south-western Nigeria, showed

that all the farmers interviewed in the area agreed to the importance of maintaining soil fertility for food crop production. Analysis of various soil management methods showed that greater number of the farmers believed the use of fallowing as the most sustainable soil management techniques use to improve soil fertility for increased production. Some of the farmers adopted the use of cover crops, mixed farming, mulching, fertilizer application, shifting cropping and minimum tillage as practicable soil management practices

[34] in his study on soil management practices of dry land soil in Northern Nigeria, posited the use of organic manure, contour/strip cropping, mulching, multiple cropping, crop rotation and cover crops as sustainable soil management techniques used by farmers in Northern part of Nigeria to improve the fertility of the soil.

POSITIVE IMPACTS OF SOIL MANAGEMENT PRACTICES ON AGRICULTURAL PRODUCTIVITY AND POVERTY REDUCTION IN NIGERIA

Agriculture is the most important economic sector of many developing countries including Nigeria. Production systems are expected to produce food for a global population of about 9.1 billion people in 2050 and over 10 billion by the end of the century [35]. For this to be achieved, agricultural production systems need to be transformed to increase the productive capacity of the small holder farmers which occupies about 80% of the farming work force [36]. However, there is a pertinent question of which technologies and practices are most appropriate to attain this objective considering the population on hand. [5] and [11] noted that greater attention is thus being given to intensification of sustainable soil management technologies. Key benefits of these technologies are; increasing food production without depleting soil and water resources, restoring soil fertility, increasing the resilience of farming systems to climatic risk, and improving their capacity to sequester carbon and climate change mitigation [12]. The use of cover crops is reported to lead to higher yields due to decreased on-farm erosion and nutrient leaching, and

reduced grain losses due to pest attacks. Crop rotation and multiple cropping are designed to ensure differential nutrient uptake and use. These techniques enhance soil fertility, reduce reliance on chemical fertility and enrich nutrient supply to subsequent crops [37] leading to increased income and yields for example, [38] showed that crop rotation increased maize yields to 3,414 kg/ha (71% increase in yields) and bean yields to 258 kg/ha (158% increase in yields). Again, increased crop yields after a fallow period have been widely reported by [39] although the magnitude of yield increment after each successive fallow is variable. Adopting organic fertilization (Compost and animal manure) is widely found to have positive effects on yields. [40] reported that farmers in Bolivia increased potato yields by 20% using organic fertilizers. Increasing the proportion of nutrients retained in the soil for example, through mulching is also expected to have positive effects on crop yields. Consequently, farmers that adopt zero / minimum tillage and crop residue management provide opportunities for increasing soil water retention. Therefore, their crop yields are often higher relative to conventional tillage especially in semi-arid and dry-humid agro-ecosystems. Proper water control mechanisms through (contour and strip cropping) can help reduce soil loss and increased soil quality and yields [39]). [41] showed that contour and strip cropping led to about 150% increase in a range of upland crops. He reported that contour hedgerows improved maize yields up to 15% compared with conventional practices on hillside farms in the Philippines. Agro forestry which refers to soil-use techniques in which woody perennials (alley and taunga farming) are deliberately integrated with agricultural crops varying from very simple and sparse to very complex and dense systems help to improve land productivity by providing a favourable micro-climate and permanent cover, as well as improved soil structure, organic carbon content, increased infiltration and enhanced fertility reducing the need for chemical fertilizers which have adverse effect in the long run [42]. Sustainable soil management practices also generate both private and public benefits and thus constitute potentially an important means of generating "win-win" solutions to addressing poverty and food security as well as

environmental issues. Good soil management techniques contribute to improving soil fertility and structure, adding high amounts of biomass to the soil, causing minimal soil disturbance, conserving soil and water, enhancing activity and diversity of soil fauna, and strengthening mechanisms of crop residue cycling [9]. These in turn translates to better plant nutrient content, increased water retention capacity and better soil structure, potentially leading to higher yields and greater system resilience, thus contributing to increased land productivity, food security, poverty reduction and improve rural livelihoods [9]. Again, wide spread adoption of good soil management practices have the potential to generate significant public environmental goods in form of improved watershed functioning, biodiversity conservation and carbon mitigation. The technical potential for mitigation from agriculture by 2030 is estimated to be between 4,500 and 6,000 MtCO₂ / year which can be reached by reducing emissions of which agriculture is an important source representing 14% of the global total and increasing soil carbon sequestration which constitute 89% of agriculture technical mitigation potential [43]. Good soil management practices can increase the levels of soil organic matter of which carbon is the main component. Improving productivity would also reduce the need for additional land conversion to agriculture, which on its own represents almost as much GHG emissions as those directly generated from agricultural activities. Consequently, sustainable soil management practices raises the income levels of small holder farmers through the proceeds of the farms, ensure higher prices of food commodities and reduced production risk [31].

NEGATIVE IMPACTS OF SOIL MANAGEMENT PRACTICES ON LAND PRODUCTIVITY AND INCOME OF HOUSEHOLD FARMERS

Soil degradation which manifests itself in the form of soil erosion and nutrient depletion is a very serious problem many countries are grappling with including Nigeria. [44] indicate that at globally nearly 1.9 billion hectares of land which hosts about 1.5 billion people is degraded through poor soil management practices. On average, 5-8 million hectares of land gets out of production

annually. According to the estimates of [45], only 12% of African soils are moderately fertile or well drained, compared to 33% in Asia, while about 88% is infertile covering an area of about 494 million hectares in the continent. Although soil's in most developing African countries have inherently low fertility as a result of poor and inadequate replenishment. According to [46] unsustainable soil practices have been identified as one of the most serious ecological and economic problems facing Nigerian Agriculture. About 85% of soil deterioration is caused by soil erosion, water and wind. Therefore, health of Nigerian soils has become a constant challenge for farmers and agriculturists in the country. Poor soil management practices is the fundamental cause of declining in per capita food production of household farmers in Nigeria and this has consistently lowered their standard of living (low incomes) and thus, increased their poverty levels. More than 66.7% of the populace in Nigeria depends on agriculture as a source livelihood but productivity has been disappointingly declining over several decades [47]. In Nigeria, poor soil management activities include; bush burning, continuous cropping, deforestation, indiscriminate vegetation removal, over grazing and use of marginal lands for agricultural purposes which often precede eventual degradation of soil resources and environmental damages [8]. Poor cultivation techniques have resulted in decrease of soil fertility, reduction of soil organic matter, and increase in occurrence of acidified soils. Decline in soil fertility as a result of soil degradation decreases land productivity. Escalating rates of soil nutrient mining makes nutrient loses highly variable in agricultural areas of sub-humid and humid savannah from moderate to severe loss of nutrients. [48] estimated that annual net nutrient depletion rates per hectare exceeded 30kg of nitrogen and 20kg of phosphorus in arable soils of several countries. In many parts of agro-ecological zones of Nigeria where poor soil management methods prevail, long term productivity of soil is projected to decline considerably unless soil management techniques improves. However, unsuitable soil practice such as continuous cropping pattern which is widely practiced by small holder arable crop farmers as a result of poor land tenure systems has in no small measure

contributed to a decline in agricultural productivity [49]. Continuous cropping is the cultivation of a particular piece of land on yearly basis without adequate attention on replenishing lost nutrients. This practice leads to poor yield of crops and causes the soil to lose its fertility. Furthermore, other practices such as bush burning, deforestation, over-grazing, flooding, stumping and poor tillage practices, destroys the soil structure, texture, microbio organisms as well as exposes the soil to erosion and leaching thereby making the farmland infertile and unproductive in nature [34]. Consequently, poor farmers are led to clear forest, cultivate steep slopes without conservation, plough fallow land before it has recovered its fertility, attempt to obtain multiple crops by irrigating unsuitable soils overgraze rangelands and make unbalanced fertilization applications. All these reduced land productivity which leads to low agricultural output of farmers. [14] reiterated that most household farmers engaged in poor and unsustainable soil management practices which include; improper removal of stubble or fallow cover leading to erosion, insufficient fallow time leading to decline in soil fertility, over production of single crop types leading to nutrient depletion, over removal of tree cover leading to water table elevation and /or salinity, over irrigation of farm lands leading to turbidity and salinity, excess tillage of fragile soils leading to erosion and over grazing of farm lands leading to desertification which encroaches on arable farm lands of small holder farmers. In addition, unsustainable soil practices (e.g. inadequate replacement of soil nutrients taken up by crops) have led to accelerated depletion of the natural soil base available for food production [18]. However, Conflicting interests in the exploitation of soil resources by various stakeholders has led to mismanagement, and in some cases, deterioration of soils. Furthermore, low soil fertility inevitably leads to low agricultural productivity since agricultural development is fundamentally affected by productivity status of soil resources. Poor soil management and fragile nature of tropical soils generally account for heavy nutrient losses through soil erosion and nutrients leaching soils. Subsequently, unsuitable soil management practices place significant pressures on soil health,

while increased stock grazing on farmlands increases the potential for soil compaction, pugging and erosion. Again, stock grazing on wet

soils reduces the amount of water and air movement in soil thereby making root penetration more difficult [20].

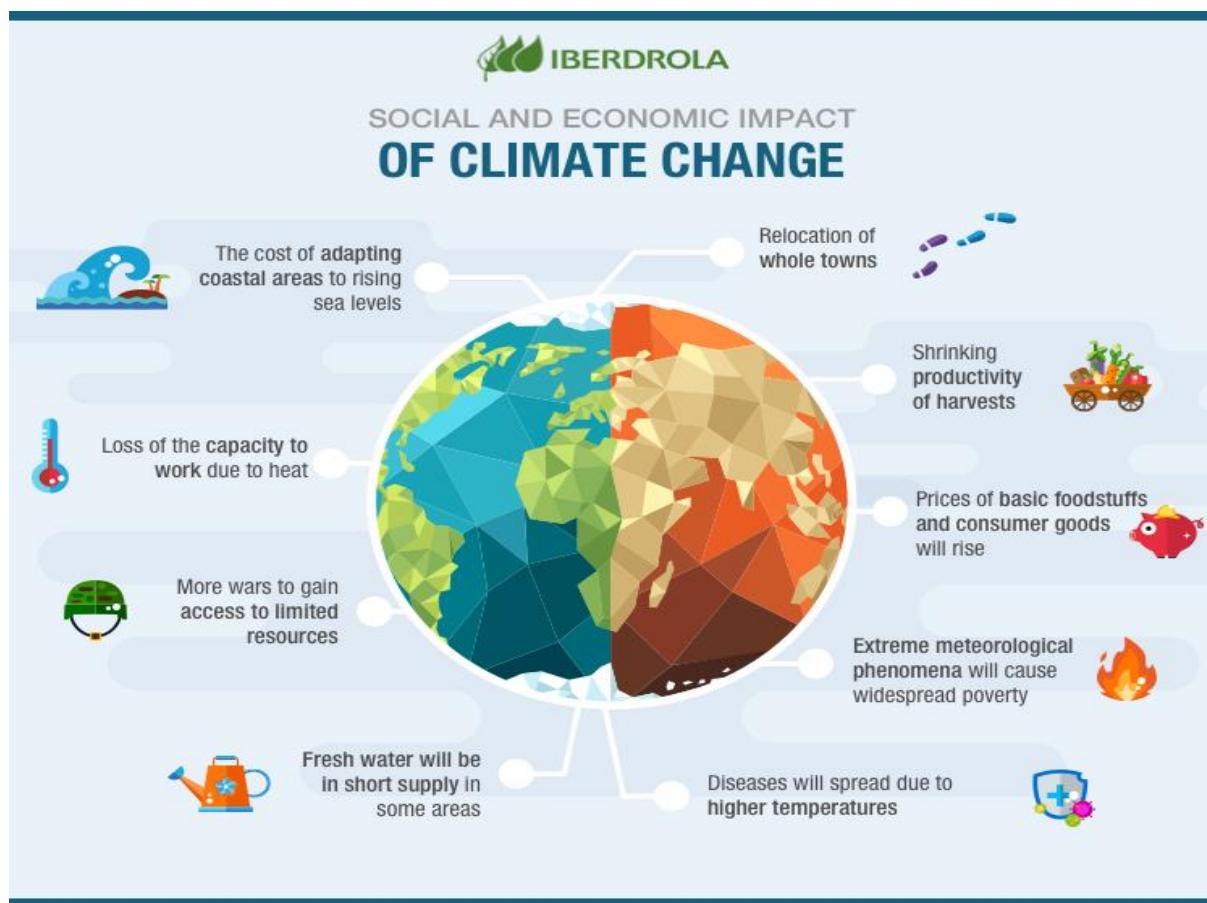


Figure 1: Impacts of Climate Change on Nigerian Agriculture

Source: FAO, (2010).

Table 1: Suitable and un-suitable soil management practices of household farmers'

Suitable soil management practices	Un-suitable soil management practices
1. Crop rotation	Inorganic fertilization
2. Alley cropping	Continuous cropping
3. Taungya farming	Marginal land cultivations
4. Mulching	Bush burning
5. Zero/minimum tillage practices	Deforestation
6. Shifting cultivation	Over-grazing
7. Bush fallowing	Vegetative removal
8. Contour cropping	Improper stubble removal
9. Strip cropping	Insufficient fallow periods
10. Use of organic manure	Over removal of tree cover
11. Multiple cropping	Over production of single crops
12. Cover cropping	Excess tillage practices
13. Legume planting	Over irrigation of farmlands
14. Conservation tillage	Poor residue management
15. Inter-cropping	Poor fertilizer application
16. Crop residue recycling	Poor ridging
17. Good Ridging patterns	Poor erosion control measures
18. Good erosion and control measures	Poor disease management
19. Pest/disease managements	Poor planting/spacing of crops
20. Mixed cropping/farming	Poor drainage channels/systems
21. Efficient drainage systems	Improper crop weeding
22. Good irrigation methods	Poor pest management

Source: Osuji et al. (2020)

CONCLUSION AND RECOMMENDATIONS

Agriculture which is the bedrock occupation of the rural households had experience a lot of setbacks due to total neglect and other pertinent factors such as climate change and soil management practices employed by the household farmers. Empirical studies have shown that climate change can distort the pathway for economic growth and increase poverty status of farming households in Nigeria. Nigeria has witnessed increased run-offs due to rainfall intensities and untold climatic variations which had negatively affected household income and agricultural productivity at large. Variation in Rainfall is expected to continue

to rise with the southern areas experiencing rising precipitation of sea levels and to an extent exasperate submersion of the coastal lands cum flooding. Droughts have equally become a predominant factor in the Northern Nigeria, occasioned from a decline in precipitation and increase in temperature. Greater attention is thus being given to intensification of sustainable soil management technologies. Key benefits of these technologies are; increasing food production without depleting soil and water resources, restoring soil fertility, increasing the resilience of farming systems to climatic risk, and improving their capacity to sequester carbon and climate change mitigation. Conclusively, farmers should

embraced climate change mitigation strategies and adaptative principles and incorporate efficient and effective soil management techniques to forestall future climatic occurrences and boost farm production and income.

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